SOUTHEAST ASIAN FISHERIES DEVELOPMENT CENTER

REGIONAL GUIDELINES FOR RESPONSIBLE FISHERIES IN SOUTHEAST ASIA

RESPONSIBLE AQUACULTURE

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Regional Guidelines for Responsible Fisheries in Southeast Asia –Responsible Aquaculture

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Preface

Aquaculture is an important solution to the problem of declining fisheries catch brought about by intense fishing pressure due to the rapidly increasing world population and demand for food. Aquaculture is particularly important in Asia, which accounts for 90% of the world production. The species farmed in Asia range from seaweeds to herbivorous fishes and mollusks to carnivorous fishes, shrimps, and crabs. Carps have been farmed for three thousand years in China, and milkfish have been farmed for hundreds of years in Indonesia and the Philippines. Such length of time indicates that aquaculture can be sustainable.

Unfortunately, aquaculture like capture fisheries can also be subject to abuse. Irresponsible fishing and farming practices can destroy sensitive ecosystems, lower biodiversity, and cause social conflicts, all in the pursuit of short-term gains. Recent events have shown how unsustainable some forms of aquaculture can be. For example, the shrimp culture industry has boomed and collapsed within a few years in several countries in Asia. But with the industry decline, there also lies hope. In most cases, the collapse has been followed by gradual recovery as humbled growers realize the folly of the 'slash-and-burn' type of aquaculture and adopt more responsible practices.

The FAO Code of Conduct for Responsible Fisheries could not have come at a better time. Increasing demand for fish is fueling the intensification of both capture fisheries and aquaculture, in some places resulting in ecosystem damage and socioeconomic problems. Article 9 on Aquaculture Development aims to forestall or mitigate the negative effects of aquaculture. The implementation of the Code in general and of Article 9 in particular is a long-term process and necessitates the commitment and support of all governments or States.

The Regional Guidelines for Responsible Fisheries in Southeast Asia - Responsible Aquaculture is the second of a series of Regional Guidelines developed by the Southeast Asian Fisheries Development Center (SEAFDEC) to elaborate the FAO Code of Conduct for Responsible Fisheries in the southeast Asian context. These Regional Guidelines have been developed under the collaborative mechanism of the ASEAN-SEAFDEC Fisheries Consultative Group with the financial support of the Government of Japan Trust Fund. In this second edition, we have added more definitions, explanations, and examples to accompany the agreed guidelines.

The SEAFDEC Aquaculture Department hopes that the governments of the SEAFDEC Member Countries will implement the guidelines and make their respective aquaculture industries dynamic, socially relevant, profitable, and sustainable.

Rolando R. Platon, PhD
AQD Chief

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Sustainable development
Development that meets the needs of the present without compromising the ability of future generations to meet their own needs (Brundtland 1987)

Management and conservation of the natural resource base and the orientation of technological change in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations. Such sustainable development (in the agriculture, forestry and fisheries sectors) conserves land, water, plant and animal genetic resources, is environmentally non-degrading, technically appropriate, economically viable and socially acceptable (FAO 1988)

Introduction

To help ensure that future generations will be able to avail themselves of the resources of the seas and inland waters, the 28th Session of the FAO Conference on Fisheries held on 31 October 1995 adopted the FAO Code of Conduct for Responsible Fisheries. The Code was the result of four years of work following the International Conference on Responsible Fishing in Cancun, Mexico in May 1992. Fisheries experts from around the world deliberated long and hard to come up with the final Code document. Article 9 of the Code is on Aquaculture Development. The 1995 Conference also directed FAO to elaborate technical guidelines for the implementation of the Code. Thus, the FAO Technical Guidelines for Responsible Fisheries No. 5: Aquaculture Development was published in 1997.

The FAO Technical Guidelines apply in the general sense to aquaculture in Southeast Asia. However, it was necessary to elaborate on the articles of the Code to make clearer their application in Southeast Asia. Thus, the Southeast Asian Fisheries Development Center (SEAFDEC) conducted a series of technical consultations involving all the ASEAN-SEAFDEC Member Countries. These consultations allowed SEAFDEC to produce three volumes of Regional Guidelines for Responsible Fisheries in Southeast Asia - Responsible Fishing Operations in 1999, Responsible Aquaculture in 2001, and Responsible Fisheries Management in 2003.

FAO Code of Conduct for Responsible Fisheries

The Code "sets out principles and international standards of behaviour for responsible practices with a view to ensuring the effective conservation, management and development of living aquatic resources, with due respect for the ecosystem and biodiversity." The Code recognizes the nutritional, economic, social, environmental and cultural importance of fisheries and the interests of those involved in the fishery sector. The Code is global in scope and is directed towards members and non-members of FAO, fishing entities, subregional, regional and global organizations, whether governmental or non-governmental, and all persons concerned with the conservation of fishery resources and management and development of fisheries, such as fishers, those engaged in processing and marketing of fish and fishery products and other users of the aquatic environment in relation to fisheries.

The Code is voluntary but is based entirely on international law especially the United Nations Convention on the Law of the Seas. The Compliance Agreement is binding (Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas).

Responsible fisheries
Use or harvest of aquatic resources in harmony with the environment - a concept encompassing capture (fishing) and culture (farming) methods and practices that are not harmful to ecosystems and resources, transformation processes that add value to the products and meet the required sanitary standards, and commercial practices that provide consumers good quality products.

'Regionalization' of the FAO Code of Conduct

To be globally acceptable, the *FAO Code of Conduct for Responsible Fisheries,* as finally worded is the product of compromise and consensus on controversial issues. Specific regional issues were diluted, glossed over, or perhaps even avoided altogether. Realizing this situation, the Council of Directors of the Southeast Asian Fisheries Development Center (SEAFDEC) approved a program for the 'regionalization' of the FAO Code during the 30th Council Meeting at Bandar Seri Begawan, Brunei Darussalam on 17-21 March 1998. Since there can only be one Code and one set of standards that should apply globally, 'regionalization' was taken to mean the preparation of a set of guidelines such that the issues of particular importance to southeast Asia can be elaborated on.

In 1999, the SEAFDEC Aquaculture Department prepared the regional guidelines for Article 9 (Aquaculture Development) of the Code. A list of considerations was drawn up and circulated to the fisheries agencies of all the Member Countries for their respective aquaculture experts to review. A Technical Meeting of Experts held in Iloilo City, Philippines, from 31 July to 2 August 2000, produced a set of draft regional guidelines.

The Core Aquaculture Experts were soon after identified: Mr. Haji Abdul Rajid Haji Metali of Brunei Darussalam, Mr. Srun Lim Song of Cambodia, Mr. Anto Sunaryanto of Indonesia, Mr. Bounma Luang Amath of Lao PDR, Mr. Kathamuthu Subramanian of Malaysia, Mr. U Hla Win of Myanmar, Mr. Nelson Lopez of the Philippines, Ms. Renee Chou of Singapore, Mr. Siri Tookwinas of Thailand, and Mr. Tran Van Quynh of Vietnam. The Core Experts Consultation was held on 21-22 November 2000 in Iloilo City. The Core Experts deliberated on the draft guidelines and made sure important regional issues were covered. The revised regional guidelines were then circulated to all Member Countries. Each country held a national seminar between February and May 2001 to allow the various stakeholders in the aquaculture sector to review the regional guidelines.

On 17-19 July 2001, the Regional Technical Consultation on the Code of Conduct for Responsible Fisheries —Aquaculture Development was convened in Iloilo City. In attendance were the Core Experts, the representatives of the various southeast Asian governments, and the scientists and officials of SEAFDEC/AQD. Another round of deliberation, review, and revision of the regional guidelines was conducted. Finally, a consensus was reached on the final wording of the *Regional Guidelines for Responsible Fisheries in Southeast Asia —Responsible Aquaculture*. SEAFDEC/AQD obtained the commitment of the Country Representatives that their governments will support and implement the *Regional Guidelines*.

Participants of the Regional Technical Consultation on the Code of Conduct for Responsible Fisheries: Aquaculture Development

During the ASEAN-SEAFDEC 'Fish for the People' Millennium Conference in Bangkok, Thailand on 19-24 November 2001, the *Regional Guidelines for Responsible Fisheries in Southeast Asia — Responsible Aquaculture* was distributed to the various aquaculture stakeholders and the Ministers of the Member Countries of the ASEAN (Association of Southeast Asian Nations). The Conference included panel sessions on Aquaculture, Fisheries Management, Fish Trade, Fisheries Post-Harvest Technology, Fisheries Statistics, and Fisheries Cooperation. At this Conference, the Ministers adopted a *Resolution on Sustainable Fisheries for Food Security in the ASEAN Region.* They resolved, without prejudice to the sovereign rights, obligations, and responsibilities of Countries under international law, to elaborate regional policies on fisheries, and undertake further collaborative actions and mutual assistance on the priority issues. The Ministers also adopted the *Regional Guidelines for Responsible Fisheries in Southeast Asia* as an instrument for the implementation of the provisions of the *FAO Code of Conduct for Responsible Fisheries.*

Rationale of the Regional Guidelines

The *Regional Guidelines for Responsible Fisheries in Southeast Asia —Responsible Aquaculture* was prepared fully taking into account the diversity as well as the specific social, economic, cultural, ecological, and institutional contexts of ASEAN fisheries.

Southeast Asian traditions and culture. Although the traditions and cultures of the ten countries comprising SEAFDEC and the Association of Southeast Asian Nations (ASEAN) are varied, at least two things stand out in common. First, the peoples of all the ten countries are fish-eating, meaning, fish is part of the daily diet and is a major if not main source of animal protein. Second, aquaculture forms part of each country's traditions and economy. Aquaculture is already part of daily life and products of aquaculture already contribute to the meal tables in all the ten countries. This being the case, the existence and practice of aquaculture no longer need to be justified in the region. Aquaculture only has to be rationalized in the light of increasing pressure to intensify production and the inherent setbacks when farmers do not behave responsibly.

Structure of the aquaculture industry in Southeast Asia. Due to the long tradition, the aquaculture industry in the region is very heterogeneous in terms of the species being farmed and the scales of operation. Aquaculture enterprises range from a small fish cage owned and run by a farming or a fishing family to augment their food and income, to several hundred hectares of fish or shrimp ponds owned by a company and run by hired workers. Marketing can be on a farm-gate basis with the buyer picking up the freshly harvested fish, or can involve processing, cold storage, and eventual shipment of the product to a foreign country. The industry is also multi-tiered, consisting of pond, pen, and cage builders, fry gatherers and dealers, feed and other input suppliers, harvesters, processors, and buyers and sellers at different levels.

Southeast Asian ecosystems. The region is largely tropical and monsoonal. Seasons for breeding and growing aquatic products are many months long, dictated more by rain, wind, and salinity than by temperature. Since the temperature is nearly always optimum, breeding and grow-out can take place the whole year. The region's inland and coastal ecosystems and the component flora and fauna are highly diverse. Such diversity makes possible the diversity of aquaculture practices in the region. The complexity of ecosystems also makes the introduction of exotic or non-native species more dangerous and harder to predict. A seemingly benign introduced exotic such as tilapia can eliminate native species in lakes. Disease agents in introduced species can be lethal to non-immune native species and can be difficult to eradicate from the ecosystem. A greater amount of caution is therefore needed before introductions of exotic species are allowed in southeast Asian ecosystems.

Area of coverage

This document, the *Regional Guidelines for Responsible Fisheries in Southeast Asia –Responsible Aquaculture* facilitates the implementation of the *FAO Code of Conduct for Responsible Fisheries* by the ASEAN countries and applies to aquaculture in marine, brackishwater, and freshwater environments. Although the *Regional Guidelines* has been prepared primarily by and for the SEAFDEC and ASEAN Member Countries, the other countries in Asia with the same set of circumstances may also find the *Regional Guidelines* useful.

International legal instruments

Aquaculture operations are generally private enterprises and very rarely cross national boundaries. The international laws, Agreements and Conventions referred to in the *FAO Code* generally have no provisions on aquaculture, except two international agreements, of which all the SEAFDEC and ASEAN Member Countries are signatories or Parties. One is the Convention on the International Trade of Endangered Species of Wild Fauna and Flora (CITES), which sets requirements and controls on the transport and trade of organisms considered endangered or threatened, or that are protected by at least one Party. The other is the Office International des Epizooties (OIE) which requires the immediate reporting of the occurrence of certain diseases in aquaculture.

Role of Southeast Asian States

States have the responsibility to manage aquaculture development within their jurisdictions. Southeast Asian States may do the following:

- Initiate necessary action identified in the Regional Guidelines.
- Prepare technical guidelines to clarify the concepts and issues in the Regional Guidelines.
- Improve the national legal instruments.
- Promote the required policy and technical research to obtain needed or detailed information.

Role of the SEAFDEC Aquaculture Department

The Aquaculture Department of SEAFDEC continues to work with international research and development organizations and national and local governments, universities, farmer groups, and other stakeholders to promote responsible aquaculture. AQD implements programs in research, training and information, and technology verification and commercialization towards sustainable aquaculture in the region. AQD disseminates the *Regional Guidelines for Responsible Fisheries in Southeast Asia –Responsible Aquaculture* for ever wider application.

Aquaculture
Farming of aquatic organisms including fish, mollusks, crustaceans, echinoderms, and aquatic plants. Farming implies some form of intervention in the rearing process to enhance production, such as regular stocking, feeding and protection from predators. Farming also implies individual or corporate ownership of or rights resulting from contractual arrangements to, the stock being cultivated primarily for livelihood and business activities. For statistical purposes, aquatic organisms harvested by an individual or corporation, which has owned them throughout their rearing period contribute to aquaculture, whereas aquatic organisms exploited by the public as a common property resource, with or without appropriate licenses, are the harvest of fisheries (FAO 1988)

Excerpts from the FAO Technical Guidelines

Aquaculture is currently one of the fastest growing food production systems in the world. Most of the global aquaculture output is produced in developing countries, and significantly in low-income, food-deficit countries. With stagnating yields from many capture fisheries and increasing demand for fish and fishery products, expectations for aquaculture to increase its contribution to the world's production of aquatic food are very high. There is also hope that aquaculture will continue to contribute to food security and poverty alleviation in many developing countries.

Aquaculture encompasses a very wide range of farming systems and practices, using many species, in different environments. This diversity offers a wide range of options for enhanced food production and income generation in rural and peri-urban areas. The vast majority of aquaculture practices around the world have been pursued with significant nutritional, social, and economic benefits, and generally little or no environmental costs. However, it is essential for current efforts aiming at the future success of aquaculture in both developing and developed countries, that potential social and environmental problems are duly addressed in order to ensure that aquaculture develops sustainably.

Aquaculture, like all terrestrial farming systems, is to face a number of challenges including increasing competition for limited resources, such as water, land and feed inputs; lack of recognition as legitimate resource user; lack of institutional and legal support; over regulation; and recently, harmful publicity resulting from relatively few cases of environmental degradation and social disruption caused by some aquaculture practices.

Given the diversity in aquaculture and sometimes different perceptions of sustainability, more balanced and informed approaches are required to address developmental and environmental issues at any given location. Commitment to collaboration, constructive dialogues among partners, and participation of aquafarmers and their communities are important when assigning responsibilities for sustainable development of aquaculture.

Although the *Code of Conduct for Responsible Fisheries* stipulates actions to be taken by States, it is also meant to address persons, interest groups or institutions, public or private, who are involved in or concerned with aquaculture. Providing an enabling environment for sustainable development in aquaculture is the responsibility of people in governments and their institutions, but also of social and natural scientists, media, financial institutions, special interest groups, as well as of aquaculture producers, manufacturers and suppliers of inputs, processors, and traders of aquaculture products.

The *FAO Technical Guidelines for Responsible Fisheries No. 5: Aquaculture Development,* published in 1997, provides annotations to the Principles of Article 9 of the *Code of Conduct for Responsible Fisheries.* These annotations are meant to serve as general guidance, and should be taken as suggestions or observations intended to assist those interested in identifying their own criteria and options for action, as well as partners for collaboration in support of aquaculture development.

Integrated Ecosystems Management

The ecosystem approach is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. It is based on a collaboratively developed vision that integrates ecological, economic and social factors. It is applied within a geographic framework defined by ecological boundaries. It recognizes that humans, with their cultural diversity, are an integral component of ecosystems. It is based on the application of appropriate scientific methodologies focused on the essential processes, functions and interactions among organisms and their environment. The approach provides the framework that draws together national, local and community-based management practices to achieve the ultimate goal of a healthy and sustainable environment.

Adopted as the primary framework for action by the Conference of the Parties of the Convention of Biological Diversity, at its Fifth Meeting in Nairobi, 2000. The ecosystem approach goes by 12 Principles:

- The objectives of management of land, water and living resources are a matter of societal choices.
- Management should be decentralized to the lowest appropriate level.
- Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems.
- Recognizing potential gains from management, there is a need to understand and manage the ecosystem in an economic context — and reduce market distortions that adversely affect biological diversity, align incentives to promote biodiversity conservation and sustainable use, and internalize costs and benefits.
- Conservation of ecosystem structure and function to maintain ecosystem services, should be a priority of ecosystem management.
- Ecosystems must be managed within the limits of their functioning.
- Management should be undertaken at the appropriate spatial and temporal scales.
- Objectives for ecosystem management should be set for the long term.
- Management must recognize that change is inevitable.
- There should be appropriate balance between, and integration of, conservation and use of biological diversity.
- All forms of relevant information must be considered, including scientific data, indigenous and local knowledge, innovations, and practices.
- All relevant sectors of society and scientific disciplines must be involved.

Sustainable use

Sustainable use entails the introduction and application of methods and processes for the utilization of biodiversity to prevent its long-term decline, thereby maintaining its potential to meet current and future human needs and aspirations.

Article 10 of the Convention on Biological Diversity sets the sustainable use agenda as follows:

- Integrate conservation and sustainable use of biological resources into national decision-making.
- Adopt measures to avoid or minimize adverse impacts on biological diversity.
- Protect and encourage customary use of biological resources in accordance with traditional practices and conservation.
- Support local populations to develop and implement remedial action in degraded areas with reduced biodiversity.
- Encourage government and the private sector to cooperate in developing methods for sustainable use of biological resources.

Regional Guidelines for Responsible Fisheries in Southeast Asia

–Responsible Aquaculture

Objectives

- To clarify the requirements of the *FAO Code of Conduct for Responsible Fisheries*
- To facilitate the formulation of regional policies to enable the implementation of the *FAO Code* in the ASEAN-SEAFDEC Member Countries
- To facilitate the formulation and implementation of national codes of practice for responsible aquaculture by the ASEAN-SEAFDEC Member Countries

Inside

The *Regional Guidelines* are tabulated alongside the principles of Article 9 of the *FAO Code of Conduct for Responsible Fisheries.* Definitions of terms and some examples are given by way of explanation. Some annotations from the *FAO Technical Guidelines* (FAO 1997) are included.

Article 9.1. Responsible development of aquaculture, including culture-based fisheries, in areas under national jurisdiction.

Aquaculture has been recognized for its important role in the food security programs of governments in the region. Thus, governments are mainly responsible for promoting and regulating present and future aquaculture development within their national jurisdiction. Rapid development of aquaculture in the region and elsewhere necessitates that governments ensure that aquaculture be technically appropriate, economically viable, socially acceptable, and environment-friendly. Where countries in the region have existing laws and regulations, these should be properly implemented and enforced. Where laws and regulations are lacking, national governments must develop the legal frameworks to ensure that the aquaculture sector is adequately regulated and protected. These frameworks must clearly define the responsibilities of the State and the farmers and include evaluation of the impact of aquaculture on natural resources and human communities.

Original Article	*Regional Guidelines*
Article 9.1.1 States should establish, maintain, and develop an appropriate legal and administrative framework, which facilitates the development of responsible aquaculture.	*1) States should regularly compile, review, evaluate, and update all information, laws, and regulations pertaining to aquaculture and related activities.* *2) States should improve the national statistical system covering aquaculture and using a format compatible with regional and global databases.* *3) States should take all reasonable and practicable measures to ensure that there are no conflicts in existing laws and regulations and that they are properly implemented and complied with.* *4) States should establish the legal framework for the use of non-land based aquaculture, emphasizing the integration of aquaculture into coastal area management.*
Article 9.1.2 States should promote responsible development and management of aquaculture, including an advance evaluation of the effects of aquaculture development on genetic diversity and ecosystem integrity, based on the best available scientific information.	*1) States should promote research on the ecological and socioeconomic impact of aquaculture, including the ecological footprint of aquaculture, and include such information in planning and management.* *2) States should conserve local genetic diversity and ecosystem integrity and evaluate the effects of species introductions carefully.*

Culture-based fisheries
Capture or harvest of aquatic organisms grown in open waters from artificially stocked seed produced from hatcheries

Food security
The situation that exists when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life

State
National government, or any level government in charge of development and regulation

Legal and administrative framework
Government agencies and authorities and the appropriate laws, regulations, orders, agreements, including codes of practice, that develop, promote, and manage aquaculture

Code of Practice
A set of concepts, principles, or policy statements that prescribe preferred ways of doing and acting to achieve standard or desired results. A 'soft law' that often suits best the purposes of regulating aquaculture practices

Statistical system
The process, procedures, and network for collecting information on fisheries and aquaculture (operators, methods, technologies, inputs, outputs, production volumes, value, prices, markets, etc.)

Government responsibility

Government authorities are responsible for existing and future aquaculture developments, and in many countries will continue to play a major role in promoting and regulating aquaculture development. Frequently, aquaculture is still under a general fisheries basic legislation, and is often not being recognized as the aquatic equivalent to agriculture. In many countries, existing administrative and legal frameworks may need to be adjusted to address specific characteristics and needs of the sector. Likewise, legal provisions and regulatory measures may need to be streamlined so as to clearly set forth the privileges and responsibilities of aquaculturists. There is much scope for increasing awareness of both public institutions and the general public about aquaculture and its similarities with agriculture. This may be achieved through collaborative efforts by aquafarmers, authorities, media, and non-government initiatives. Such awareness would contribute to the formulation of appropriate laws and regulations that reflect recognition of the characteristics and needs of aquaculture. (FAO 1997)

Original Article	*Regional Guidelines*
Article 9.1.3 States should produce and regularly update aquaculture development strategies and plans, as required, to ensure that aquaculture development is ecologically sustainable and to allow the rational use of resources shared by aquaculture and other activities.	*1) Given the importance of small-scale aquaculture in the region, States should address the concerns of food security, poverty alleviation, and income generation in aquaculture development plans.* *2) As much as practicable, States should provide basic infrastructure and assistance for ecologically sustainable aquaculture development.* *3) States and the region should adopt an integrated approach to the development, maintenance, preservation, and sustainable use of aquaculture areas including lakes, rivers, mangroves, and other aquatic ecosystems.* *4) Given the importance of mangroves, States and regional institutions should prepare regional guidelines for the responsible use of mangroves for aquaculture. States should ensure coordination among departments, agencies, and other units that have jurisdiction and stake in mangroves.* *5) States should ensure that abandoned and unutilized aquaculture facilities are rehabilitated as far as possible to an ecologically sustainable system.*
Article 9.1.4 States should ensure that the livelihoods of local communities, and their access to fishing grounds, are not negatively affected by aquaculture developments.	*1) In the use of resources for aquaculture development, States should recognize the needs of other users, promote cooperation, and minimize resource-use conflicts.* *2) States should establish appropriate zones for aquaculture development and other uses.* *3) States should ensure that aquaculture operations are coordinated or integrated with other food production sectors, and with economic and cultural activities.*

Ecosystems
Ecological systems such as mangroves, coral reefs, seagrass beds, lakes, rivers, etc.

Ecosystem integrity
Maintenance of the natural biological diversity, interactions, connections, and functions of ecosystems

Ecological footprint
The total ecosystem area required to support a unit area of farm in terms of the resource inputs (water, land, feed, seed, etc.) and ecological services (such as nutrient cycling)

Integrated coastal zone/area management
Sustainable use and conservation of coastal ecosystems and resources according to an integrated plan prepared and implemented through a continuous process that unites government and the community, sectoral and public interests, and science and management

Small-scale aquaculture
Farming and husbandry of aquatic organisms to augment nutrition or income. The operation uses limited capital and family or household labor

Infrastructure for aquaculture
Includes common waterways, water and sludge treatment facilities, postharvest facilities, farm to market roads, access to financing, power, and communication

Mangroves
In particular, the tropical salt-tolerant trees, or in general, the tropical coastal ecosystem where these salt-tolerant trees and associated plants live together with a large variety of mollusks, crustaceans, other invertebrates, fishes, and terrestrial vertebrates

Rehabilitation
The recovery of specific ecosystem services in a degraded ecosystem or habitat; putting in place a functioning system, but not necessarily what was there before. An example is the establishment of mangroves in abandoned fish ponds by breaching the dikes and replanting

Aquaculture zones
State-designated areas for aquaculture farms, especially fish pens and cages, mollusk rafts and stakes, and seaweed longlines

Aquaculture development plan

States are very diverse with respect to the resources available for different types of aquaculture, as well as in the degree of development of the supporting infrastructure, the strengths of the local and regional markets, and the financial resources available to provide specialist advice, training and other support to the sector.

An aquaculture sector study will establish the status of the sector and its performance and trends, identify the opportunities and constraints within it, and identify the options or strategies for its development.

Based on the sector study, a strategy for the sector enables the government to define or redefine its objectives for the sector, shows how these objectives are to be met, prioritizes activities, and describes the range of policies and the policy instruments to be employed, such as the criteria for the allocation of land and water, institutional changes, and promotion of appropriate technology use.

An aquaculture development plan will take the planning process a stage further by setting out in some detail the policy instruments to be employed, the financial, human and other resources required, and the time frame in which the planned activities will take place. Ideally, aquaculture development plans should define the responsibilities of all parties concerned, possibly in accordance with the principle and guidelines of the *Code of Conduct for Responsible Fisheries.*

It is the responsibility of every State to ensure that all development is appropriate, sustainable, and in the public interest. Aquafarms should be sited in locations that are suitable for sustainable production and income generation, prevent or minimize conflicts with other users of resources, do not create adverse effects, and respect nature reserves, protected areas, and critical or especially sensitive habitats. (FAO 1997)

Original Article	*Regional Guidelines*
Article 9.1.5 States should establish effective procedures specific to aquaculture to undertake appropriate environmental assessment and monitoring with the aim of minimizing adverse ecological changes and related economic and social consequences resulting from water extraction, land use, discharge of effluents, use of drugs and chemicals, and other aquaculture activities.	*1) States and the Southeast Asian region should develop expertise and competence to conduct risk analysis, environment impact assessment, and monitoring in aquaculture.*

Water extraction
Drawing of ground water from the aquifer or water table, not surface water from rivers, streams or lakes

Risk analysis
A process consisting of risk assessment, risk management, and risk communication
Risk assessment is a scientific process of hazard identification and characterization, exposure assessment, and risk characterization. Risk management is the process of weighing policy alternatives in the light of the results of risk assessment and if required, selecting and implementing appropriate control options, including regulatory measures. Risk communication is the interactive exchange of information and opinions concerning risk among risk assessors, risk managers, consumers, and other interested parties.

Environmental Impact Assessment
A method of analysis which attempts to predict the likely repercussions of a proposed major development (usually industrial) upon the social and physical environment of the surrounding area

Monitoring
The collection of specific information for management purposes

The diversity of aquaculture practices and environmental settings must be considered when formulating programs for environmental assessments and monitoring. In many cases, emphasis will need to be given to simplicity, flexibility, and affordability such that the authorities can enforce, and the farmers can accept, the requirements for assessments and monitoring. Consultation and participation of interested and affected parties in the formulation of requirements should be encouraged. A detailed evaluation of financial, manpower, and time requirements for environmental assessments and monitoring should precede implementation. Feasibility and cost-effectiveness must be demonstrated. (FAO 1997)

Thailand's Code of Conduct for Marine Shrimp Farming (outline of contents)

Mission statement

The marine shrimp farming industry in Thailand is committed to production of high-quality, hygienic products in a sustainable manner that provides for environmental, social, and economic benefits to present and future generations

Policy statements

Outline actions that industry will take:

- Environmental protection
- Regulatory compliance
- Quality and safety
- Efficiency
- Social responsibility
- Public consultation
- Location
- Continual improvement
- Research and development
- Monitoring and auditing
- International trade

Good management practices (GMPs)

GMPs are aquaculture practices that are effective, yet practical, in reducing environmental and social impacts.

Potential impacts of shrimp farms

A first step in developing GMPs is to identify the key impacts that have to be avoided or mitigated.

Operating guidelines and procedures for shrimp farms

- Site selection for new shrimp farms
- General pond management
- Stocking density
- Feed management
- Health management
- Therapeutic agents and other chemicals
- Effluent and solid waste management
- Social responsibility
- Farmer associations and education
- Data collection

(Tookwinas et al. 2000)

Example of simpler methods in lieu of a formal Environmental Impact Assessment

Initial Environment Examination

Intensive Marine Shrimp Farms in Thailand

Objective: To minimize the impact of intensive marine shrimp farms on coastal environment

Target: Marine shrimp farms on coastal areas of Thailand, both on the Gulf of Thailand and Andaman Sea

Methodology:

- Farmers need to register the marine shrimp farms at Fisheries District Office every year. For the registration process, the farmers have to submit farm lay-out, including culture pond, seawater storage, treatment area and drainage canal, culture method, and effluent treatment technique.
- Farmers need to report water quality in culture pond, farm sanitation and effluent (treated discharge water) every crop cycle to the Department of Fisheries.
- Farmers prepare the above reports in the format specified by the Department of Fisheries.

Effluent quality criteria: The farmers should discharge effluents into coastal environment according to the following water quality criteria:

pH	6.5-9.0
Total nitrogen	< 4.0 mg/L
Total ammonia nitrogen	< 1.1 mg/L
Total phosphorus	< 0.4 mg/L
Total suspended solids	< 70 mg/L
Hydrogen sulfide	< 0.01 mg/L
BOD, 5 days	< 20 mg/L
BOD, 20 days	< 20 mg/L

BOD is biochemical oxygen demand

Article 9.2. Responsible development of aquaculture including culture-based fisheries within transboundary aquatic ecosystems

In the region, there are several river basins and coastal areas shared by two or more countries. These include the Mekong and Ma river basins and coastal areas within the Gulf of Thailand, Bay of Bengal, and Straits of Malacca. Some practices of aquaculture and culture-based fisheries may affect, and be affected by other activities in these transboundary aquatic ecosystems. Although there are international and bilateral agreements in place, States should give special attention to the evaluation and management of risks related to aquaculture. These risks include environmental degradation, diseases, introduction of exotic species, and release of genetically altered organisms into shared water bodies.

Original Article	*Regional Guidelines*
Article 9.2.1 States should protect transboundary aquatic ecosystems by supporting responsible aquaculture practices within their national jurisdiction and by cooperation in the promotion of sustainable aquaculture practices.	*1) Neighboring States should identify transboundary ecosystems, land and water uses affecting and affected by aquaculture, and major common problems, if any.* *2) States should promote aquaculture co-management schemes between and among States and among stakeholders.*
Article 9.2.2 States should, with due respect to their neighboring States, and in accordance with international law, ensure responsible choice of species, siting, and management of aquaculture activities which could affect transboundary aquatic ecosystems.	*1) States sharing aquatic ecosystems should seek the assistance of regional and international organizations in planning and implementing aquaculture development*
Article 9.2.3 States should consult with their neighbouring States, as appropriate, before introducing non-indigenous species into transboundary aquatic ecosystems.	*1) Neighboring States should cooperate to conserve aquatic animal and plant diversity in the transboundary aquatic ecosystems.*

Consultations on non-indigenous species

Government authorities, aquafarmers, and fishery managers have a special obligation to minimize the risks of introducing non-indigenous species or stocks for aquaculture or culture-based fisheries in waters where there is a significant risk for spreading into the waters of other states. 'Non-indigenous' in the broadest sense includes organisms that are the product of domestication, selective breeding, chromosome manipulation, hybridization, sex reversal, and gene transfer.

The accidental or intentional introduction of 'non-indigenous' species to any waters should be avoided, but when deemed desirable for aquaculture or stock enhancement, must be preceded by a thorough study of alternatives and potential risks.

Neighboring countries should seek to establish effective mechanisms and procedures for consultation. Items for consultation and exchange include:

- Species, its country(ies) of origin and number of individuals to be introduced
- Breeding program or genetic modification done on the species
- Location of aquaculture site and possible routes of dispersion
- Anticipated benefits
- Anticipated and potential problems
- Monitoring program
- Contingency plan
- Reporting the introduction to FAO for inclusion in databases

(FAO 1997)

Sharing aquaculture information

During this period of global growth in aquaculture, States, in collaboration with partners, should develop appropriate means to monitor aquaculture activities, and facilitate policy formulation and development planning, through the collection of information and data relating to their farming practices and production, their economic performance, and their positive and negative effects on other activities.

Stronger collaboration is necessary to improve data acquisition and collection, collation, analysis, interpretation, dissemination, and appropriate use of information and data. Many countries need to develop or strengthen library services. Flow of aquaculture information can be facilitated through institutional linkages. States should share relevant data to permit regional and global monitoring of progress and problems, facilitate policy-making, and permit forecasting of opportunities and needs.

The demand for global, regional and national aquaculture data by a variety of users is growing rapidly. Among the data required are:

- Farmed species
- Production volumes and value
- Farming locations
- Farming systems, areas, and capacities
- Resource use (land, water, seed, feed)
- Employment in aquafarming and allied services
- Domestic and international demand
- Market opportunities
- Consumption patterns
- Trade
- Product prices

(FAO 1997)

Original Article	*Regional Guidelines*
Article 9.2.4 States should establish appropriate mechanisms, such as databases and information networks to collect, share and disseminate data related to their aquaculture activities to facilitate cooperation on planning for aquaculture development at the national, sub-regional, regional and global level.	*1) States should be responsible for immediately informing neighboring States about the occurrence of notifiable diseases and newly emerging diseases in aquaculture facilities and in the wild.* *2) States should be responsible for promptly notifying neighboring States about epizootics and natural or man-made disasters, such as red tides and oil spills, as well as the subsequent abatement of the problem.*
Article 9.2.5 States should cooperate in the development of appropriate mechanisms, when required, to monitor the impacts of inputs used in aquaculture.	*1) States should establish appropriate mechanisms for quality control and monitoring of all inputs used in aquaculture.*

Transboundary
Describes species, populations, natural systems, activities, measures, and effects that extend beyond the effective jurisdiction of a single State

Co-management
The sharing of authority, responsibility, and benefits between government and local communities in the management of natural resources, or between States in the case of transboundary resources or ecosystems

Stakeholders
Aquafarmers, industry people, organizations, institutions, and government entities involved in the aquaculture sector and have an interest in how it is developed, regulated, and managed

Notifiable diseases
Transmissible diseases on the list of the Office International des Epizooties - diseases considered to be of socio-economic and public health importance within countries and that are significant to international trade in aquatic animals and aquatic animal products.

Epizootics
Outbreaks of fish diseases

Red tides
Blooms of toxic dinoflagellates (a group of microscopic protozoans) along the coasts, usually due to presence of high nutrient input from land

Collaboration on fair trade in aquaculture equipment, feeds, and other inputs

Given that aquaculture equipment are quite specialized, and the numbers available or needed in the region are limited, there is need for enhanced cooperation in establishing production facilities, and for promotion of trade in such equipment and supplies. At the same time, adequate regulatory mechanisms should be put in place to monitor and guarantee the appropriateness and quality of materials produced and traded. Related measures designed to protect human or aquatic life or health, and the interests of consumers, should be in accordance with international agreements such as the World Trade Organization. Information on effectiveness and safety of inputs used in aquaculture should be facilitated. (FAO 1997)

Regional cooperation

States and their authorities are responsible for identifying and supporting sound aquaculture production approaches, and should, for these purposes, collaborate with other States and international institutions.

In many areas with shared water bodies, regional fisheries bodies exist and provide excellent fora for the exchange of information, expertise, and personnel. Cooperation should be enhanced in capacity-building and research on aquaculture systems most suitable to the region. Mechanisms and protocols should be elaborated for the exchange of knowledge, experience, and technical assistance in support of the best farming systems and technologies. (FAO 1997)

Article 9.3. Use of aquatic genetic resources for the purposes of aquaculture including culture-based fisheries

The local people have paramount rights over their own genetic resources, including any information and biotechnology products derived from these. States should promote the identification and characterization of local genetic resources, formulate guidelines for access to information and products covered by patents and intellectual property rights, and ensure equitable sharing of benefits from the use of these resources.

Original Article	*Regional Guidelines*
Article 9.3.1 States should conserve genetic diversity and maintain integrity of aquatic communities and ecosystems by appropriate management. In particular, efforts should be undertaken to minimize the harmful effects of introducing non-native species or genetically altered stocks used for aquaculture, including culture-based fisheries into waters, especially where there is a significant potential for the spread of such non-native species or genetically altered stocks into waters under the jurisdiction of other States as well as waters under the jurisdiction of the State of origin. States should, whenever possible, promote steps to minimize adverse genetic, disease, and other effects of escaped farmed fish on wild stocks.	*1) States should recognize the potentially serious impact of introduced species on the local aquatic biodiversity.* *2) States should consider a total ban on the introduction of species shown by appropriate risk assessment to be detrimental to local ecosystems.* *3) States should formulate guidelines for the development and use of genetically modified organisms (GMOs) and other products of biotechnology to ensure human safety and environmental protection.* *4) States should comply with the ASEAN Guidelines for Risk Assessment of Agriculture-Related Genetically Modified Organisms.* *5) States should formulate guidelines for the accreditation and licensing of sources and the labeling of genetically modified aquatic organisms.* *6) Prior information and consent of the State must be secured before the introduction and propagation of genetically modified organisms and other biotechnology products.* *7) States should monitor research and development on genetically modified organisms and promote proactive research to minimize the harmful effects of introducing these and other non-native species into natural environments.*

ASEAN Guidelines for Risk Assessment of Agriculture-Related Genetically Modified Organisms. Association of Southeast Asian Nations. http://www.aseansec.org/6226.htm

Organisms
Life forms' animals, plants, fungi, protozoans, bacteria, viruses, etc.

Species
A group of interbreeding organisms that share the same gene pool and usually (but not always) the same body form

Genetic resources
The genetic material of plants, animals, and microorganisms that are of actual or potential value as a resource for future social, economic, or environmental purposes

Biological diversity or biodiversity
The variety and variability of life on earth, comprising of ecosystems, species, populations, and gene pools in given geographic areas

Genetic diversity
Variety of genes and genotypes of populations and species in a given geographic area

Biotechnology
Processes that use living organisms, organs, tissues, cells, or genes, to make products for specific uses, or to improve or modify other organisms

Genetic improvement
Changing the genetic makeup of species or populations to improve performance or the traits considered by farmers or other users as desirable, e.g., fast growth, efficient food conversion, early or late reproduction, disease resistance, or toxicity.

Genetically altered organisms
Organisms or species whose genetic makeup is the result of human intervention. Includes hybrids, inbreds, offspring of selective breeding, and genetically modified organisms

Genetically modified organisms (GMOs)
Organisms or species whose genetic makeup has been changed through manipulation of DNA, RNA, and proteins-usually involving insertion of desired genes from or through bacteria

Transgenic species
Species that carry foreign genes

Introductions and transfers of species
Intentional or accidental transport, import, release, and dispersal of a species into an environment outside its natural or present geographic range

Exotic, non-indigenous, non-native or alien species
Species occurring in an ecosystem or biogeographic area outside of its historically known natural range as a result of intentional or accidental dispersal by human activities

Indigenous or native species
Species naturally occurring in a local ecosystem and that may also be found elsewhere in the same country or contiguous ecosystem

Endemic species
Species occurring only in a specific region or locality, usually over a relatively small area

Endangered species
Species in danger of extinction throughout all or a significant portion of its range. A species is considered endangered when the factors that make them vulnerable or cause their decline exist and continue to operate

Intellectual property
Creations of the mind: inventions, literary and artistic works, symbols, names, images, designs used in commerce, and including traditional or indigenous knowledge

Intellectual property rights
Legal ownership of, and protection for, know-how, creative works such as writing and music (copyright), inventions (patents), processes (trade secrets), identifiers (trade marks, domain names), and including licenses and distribution contracts

Patent
Exclusive right of an inventor to make, use, or sell his invention for a period of up to 20 years. Patents do not protect ideas, only structures and methods that apply technological concepts, or a defined scope of technology or industrial design.

Precautionary approach
A decision to take action, based on the possibility of significant environmental damage, even before there is conclusive, scientific evidence, that the damage will occur.

Principle 15 of the Rio Declaration on Environment and Development states that: *"In order to protect the environment, the precautionary approach shall be widely applied by the States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."*

The Precautionary Principle acknowledges that:

- People have a duty to take anticipatory action to prevent harm.
- The burden of proof of harmlessness of a new technology, process or activity lies with the proponents, not with the general public.
- Before introducing a new technology, process, or starting a new activity, people have an obligation to examine 'a full range of alternatives' including the alternative of doing nothing
- Decisions applying the precautionary principle must be open, informed, and democratic and must include all affected parties.
- It is easier and more effective to avoid harm than to restore damaged ecosystems.

Convention on Biological Diversity

This Convention is the first global, comprehensive binding agreement to address all aspects of biological diversity: genetic resources, species and ecosystems. It requires countries to develop and implement strategies for sustainable use and protection of biodiversity and provides a forum for continuing dialogue on biodiversity related issues through the annual Conference of the Parties.

Adopted in Rio de Janeiro, Brazil, June 1992 and came into force December 1993. Signed by over 150 countries. Legally binding agreement with three key objectives:

- Biodiversity conservation
- Sustainable use of biodiversity
- Fair and equitable sharing of the resulting benefits

CBD Guideline on Exotic Species

Prevent the introduction of, control, or eradicate those alien species which threaten ecosystems, habitats or species.

Invasive alien species are species introduced deliberately or accidentally into new habitats where they establish themselves, invade, outcompete natives and take over the new environments.

Intentional introductions include species for aquaculture or forestry.

Accidental introductions include organisms (viruses, parasites) accompanying those introduced for economic purposes; escapees from aquaria, zoos and other scientific facilities; and those in ballast waters and ship hulls.

The threat to biodiversity due to introduction of exotic species is considered second only to that of habitat loss.

Original Article	*Regional Guidelines*
Article 9.3.2 States should cooperate in the elaboration, adoption, and implementation of international codes of practice and procedures for introductions and transfers of aquatic organisms.	*1) States should adopt a precautionary approach and formulate appropriate guidelines for the introduction and use of non-native species in aquaculture and culture-based fisheries, especially in transboundary ecosystems. In formulating these guidelines, a compilation of all relevant legal instruments of ASEAN member countries is necessary.* *2) Established international guidelines for species introductions and transfers may be adapted for species used in aquaculture, and the specific responsibilities of States and aquafarmers must be clearly identified and delineated.* *3) States should also formulate guidelines for the movement of aquatic species within the same country.* *4) States should promote research on the impacts of introduced species on the local aquatic biodiversity.* *5) States should support the implementation of the* Asia Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals and the Beijing Consensus and Implementation Strategy *with emphasis on "phased implementation based on national needs."* *6) State in the region should integrate the* National Strategies on Aquatic Animal Health Management in the Technical Guidelines *into the national aquaculture development plans. States should provide funds for the implementation of these strategies.*

FAO/NACA. 2000. Asia Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals and the Beijing Consensus and Implementation Strategy. FAO Fisheries Technical Paper 402: 53 pp. Food and Agriculture Organization, Rome.

Managing genetic diversity

Aquaculture practices can affect genetic diversity at the species, community, ecosystem, and landscape levels. In fact, aquaculture is designed to change the landscape or ecosystem to one that is more productive. Management to protect aquatic genetic resources involves risk assessment and monitoring and should involve documentation of the 'wild' genetic resources to establish a benchmark for assessing impact.

Stocks for aquaculture or culture-based fisheries can be managed by:

- Avoiding inbreeding
- Maintaining stock integrity and not hybridizing different stocks, strains, or species
- Minimizing transfer of genetically different stocks
- Periodic assessment of genetic diversity through laboratory analysis

Natural levels of genetic diversity can be maintained by reducing the movement of genetically diverse populations within a country. Transfers of eggs, juveniles, or adults among river basins or large water bodies should be avoided. Hatcheries have a history of egg transfers over long distances and there is evidence that many of these transfers do not perform as well.

In small farms, mixing of genetically diverse stocks often leads to improved performance. However, in the case of interspecific hybrids, this improvement is seen only in the first generation cross and not in subsequent breeding of the hybrid population.

Genetic contamination of wild stocks may be avoided if the farmed stocks are made non-reproductive (sterile, triploid, or mono-sex). (FAO 1997)

Code of practice for GMOS and exotics

Several international codes of practice and procedures exist that have been adopted by developed countries and can be also be adapted for use in southeast Asia. Basic elements of the code include:

1. A proposal to introduce a particular species in a particular area for a particular purpose
2. An independent review of the proposal by competent authority, including ecological and socioeconomic risk assessments
3. Rejection, revision, or acceptance of the proposal

Once an introduction has been approved, governments should request aquaculturists to:

1. Create a fish management program including quarantine and disease diagnosis
2. Monitor and evaluate ecosystem and socioeconomic effects
3. Notify international organizations and neighboring States

A country's ability to carry out the elements of the Code will depend on the state of knowledge and the financial and human resources available.

Surveys of flora and fauna in local ecosystems can help determine what local species may be used instead of importing an exotic species. Socioeconomic information on the fishing sector and the fish consumers will also help identify those people benefiting or at risk from aquaculture development. In addition, marketing surveys can help determine the cost-effectiveness and target consumers of the proposed introduced exotic. (FAO 1997)

Natives versus exotics

Native species are often promoted as alternatives to introduced exotic species for farming. Native species may be preferred locally, may have less chance of introducing disease, and may grow better under local conditions. However, native species taken from the wild and domesticated or subjected to genetic modifications may also pose a risk to the remaining wild stocks, both from the genetic and disease standpoints.

The use of exotic species for farming should be examined very carefully, but it may be justifiable when it contributes to food security, and there are no suitable native species or varieties. Exotics are often preferable from the economic point of view—full domestication, better price, export potential, etc. (FAO 1997)

Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES)

Adopted in Washington DC March 1973 and came into force July 1975 in response to the growing concern over large-scale exploitation of wildlife for international trade, which was driving species to extinction. Aims to regulate international trade of animals and plants (dead or alive or any recognizable parts or derivatives of) threatened or endangered in the wild through a system of permits and controls

CITES requirements apply in the case of the threatened giant clams Tridacna and Hippopus spp. It has become difficult to transport, import, and export even hatchery-produced giant clams for reseeding in areas where they have been depleted.

Safeguarding endangered species

Aquaculture may contribute to the protection and enhancement of stocks of endangered species. The use of hatcheries and aquaculture facilities for the temporary protection and breeding of endangered species is a valuable facet of ex situ conservation. The breeding program should try to optimize the natural genetic variability in the species. The purpose is to produce individuals that can be released into nature once the threat to survival has been alleviated.

Where feasible and known, endangered species should be studied and managed to reduce the threat in the natural habitat. In the meantime, as a safeguard, sperm or live individuals could be conserved ex situ. The collection of species for ex situ conservation should not threaten the viability of the natural population. (FAO 1997)

Original Article	*Regional Guidelines*
Article 9.3.3 States should, in order to minimize risk of disease transfer and other adverse effects on wild and farmed stocks, encourage adoption of appropriate practices in the genetic improvement of broodstocks, the introduction of non-native species, and in the production, sale, and transport of eggs, larvae or fry, broodstock, or other live materials. States should facilitate the preparation and implementation of appropriate national codes of practice and procedures to this effect.	*1) States should formulate strategies for breeding and seed production of aquatic species for restocking in open waters (i.e., culture-based fisheries) and for genetic improvement of farmed species.* *2) States should formulate and implement a national code of practice for the release of hatchery-bred stocks, and of exotic and even native species into natural water bodies for stock enhancement.* *3) States should support appropriate research in genetics and molecular biotechnology and the establishment of needed gene banks for farmed aquatic species. Genetics research should include population studies of wild and hatchery-bred stocks.*
Article 9.3.4 States should promote the use of appropriate procedures for the selection of broodstock and the production of eggs, larvae, and fry.	*1) States should formulate guidelines for the proper collection of wild broodstock and seedstock and the proper handling of the incidental catch.* *2) States should encourage the private sector to actively engage in broodstock management and seed production.* *3) States should support research and development on species appropriate for small-scale aquaculture and provide assistance for broodstock development and maintenance and seed production of these species.*
Article 9.3.5 States should, where appropriate, promote research, and when feasible, the development of culture techniques for endangered species to protect, rehabilitate and enhance their stocks, taking into account the critical need to conserve genetic diversity of endangered species.	*1) States should promote the establishment of gene banks for endangered species.* *2) States should support region-wide collaborative research on endangered species.*

Broodstock
Aquatic animals grown to sexual maturity for breeding purposes, or wild adults captured for the same purpose

Seedstock
Young or early stages or smaller sizes of farmed aquatic plants and animals, either harvested from the wild or produced in the hatchery. Includes eggs, larvae, postlarvae, fry, fingerlings or juveniles, mollusk spats, and seaweed cuttings. Seedstock are stocked in aquaculture facilities or environments and grown to larger and higher value sizes.

Hatchery
Facilities and procedures for spawning aquatic animals, incubating and hatching the eggs, and rearing the larvae until they reach stages or sizes suitable for nursery or grow-out

Seed production
Process of producing seedstock in the hatchery

Gene banks
Collection of eggs, sperm, seeds, propagules, or other reproductive cells, tissues, organs, or organisms in storage (frozen, or in dry sterile conditions) for future use

Stock enhancement
Maintaining or sustaining the production from marine and freshwater bodies through restocking of seedstock, habitat improvements, setting up sanctuaries or protected areas, introduction of new species, or environmental engineering where found necessary or feasible

Restocking
Release of seedstock into natural water bodies that have depleted stocks of the same or different species

Sea ranching
Production and release of identifiable stocks that are intended to be harvested by the releasing agency

Incidental catch
Animals that also caught by fishing methods and gears that target other species; often killed instead of being released alive

Quality of broodstock and seedstock

States and their aquaculture authorities should promote responsible practices in the genetic improvement of broodstocks, and in the production, sale, and transport of broodstock, seedstock and other live organisms. Such hatchery practices are needed to avoid deformities or other genetic problems resulting from excessive inbreeding. They are also essential in minimizing spread of diseases.

Where wild seedstock is collected and distributed, care is required that other species are not sacrificed.

Breeding and genetic improvement

Considerable improvements have been made in farmed stocks through genetic selection and breeding programs, but few fish farmers have the required training and expertise to do such work efficiently and without significant losses of genetic fitness. Thus, it is advisable to establish specialized facilities for the development of improved stocks and the production of seed. Where this is not practicable, farmers should try to keep genetic diversity high by:

- Breeding as many fish as possible
- Using brooders and eggs from the entire spawning season
- Avoiding full-sibling or parent-offspring matings
- Keeping careful records of production parameters

Decreased hatchability, fertility, and survival, or increased deformities and diseases may be signs of inbreeding and loss of genetic diversity. They may be signs of other problems as well. Where feasible, States should require that breeding history and disease history be maintained for aquaculture stocks. This will facilitate exchange of broodstocks and seedstocks within the country and provide information to be considered if a species is to be exported. (FAO 1997)

Article 9.4. Responsible aquaculture at the production level

Aquaculture is overwhelmingly concentrated in the developing world, providing important nutritional and economic benefits to rural communities and earning foreign currency for many Asian countries. The trends within many countries toward the use of more intensive aquaculture systems and higher value species increase the potential for environmental damage and put additional stress on the socioeconomic structure of local communities.

Therefore, States should promote responsible aquaculture adopt sustainable development approaches. It is also essential that the aquaculture industry and all the stakeholders involved adopt a strong commitment for cooperation and self-regulation. States should develop standards for responsible aquaculture. Many benefits can be derived from association in producer organizations and the development of voluntary codes of practice and guidelines, in line with standards set by the States.

In the Southeast Asian region, aquaculture farms are generally small and their capital low. The aquafarmers are either not organized or except in very few cases, the associations are weak. In such a setting, there is need to provide farmers with technologies and guidelines for the efficient use of inputs to improve production and facilitate responsible practices.

Promoting responsible practices and attitudes

The trends within many countries toward the use of more intensive aquaculture systems and higher value species, often in sensitive areas could increase the potential for environmental damage and put additional stress on the socioeconomic structure of local communities. Therefore it is essential that the aquaculture industry and all stakeholders adopt a strong commitment for cooperation and self-regulation.

It is the responsibility of States to support individual farmers and the aquaculture industry in general in developing its own standards for responsible aquaculture practices. Consultations on possible incentives may be held with, and training on regulatory aspects of aquaculture may be provided to, aquafarmers and their associations, to enable them to participate in the formulation and improvement of aquaculture-specific legislations. (FAO 1997)

Enabling participation

Government officials, in collaboration with experts in aquaculture and rural development and other relevant fields, should seek to promote, at both national and community levels, the active participation of individual farmers and producer organizations in the development and management of existing and future aquaculture practices. Aquaculture practices should be selected, promoted and improved to meet the general needs of local communities and the environmental conditions at the given sites.

Advice by experienced aquafarmers can be important for the selection of appropriate sites, species and systems, as well as for decisions for design, maintenance, and operation of aquafarms. Such advice should be considered in conjunction with area and site surveys and geographic information systems when planning for resource uses in coastal and inland areas. Likewise, interests and needs of local communities should be identified when planning developments. (FAO 1997)

Original Article	*Regional Guidelines*
Article 9.4.1 States should promote responsible aquaculture practices in support of rural communities, producer organizations and fish farmers.	*1) States should promote responsible aquaculture as a means of livelihood to improve nutrition and income in small-scale fishing or farming communities.* *2) States should provide financing and infrastructure support to rural communities, producer organizations, and aquafarmers to enable compliance with regulations and the practice of responsible aquaculture.* *3) States should assist aquafarmers and producer organizations to identify appropriate aquaculture technologies and farming systems for use under different socio-economic and environmental conditions.* *4) States should promote the integration of aquaculture with other farming systems.* *5) States should document sources of inputs (fry, broodstock, feeds, etc.) and the availability and capacity of markets in order to assist aquafarmers and producer organizations in scaling and targeting the aquaculture operations.* *6) States should actively pursue technology transfer and extension, information dissemination, and training in aquaculture operations, to include resource and environmental management.*

Aquaculture production
Output of farmed aquatic organisms either for final consumption, or as raw material for transformation into other products, or for trade. Includes commodities quantified by numbers rather than by weight such as ornamental fish and hatchery output

Integrated aquaculture
Farming of aquatic plants and animals together with land crops and livestock, where water is shared and nutrients and other resources are recycled

Rural aquaculture
Small-scale farming by operators with limited capital

Aquafarmers, aquaculturists
Aquaculture farm owners and operators

Aquaculture workers
Persons engaged in aquaculture work such as repairing ponds, water supply, feeding. Excludes persons engaged exclusively in management, such as planning and accounting

Original Article	*Regional Guidelines*
Article 9.4.2 States should promote active participation of fish farmers and their communities in the development of responsible aquaculture management practices.	*1) States should enable aquafarmers and their communities to organize and to practice responsible aquaculture based on the best information available.* *2) States should enable aquafarmers to conduct an initial environmental assessment of their farms before starting large-scale projects.* *3) States should support the establishment of networks to enable aquafarmers to access markets and services from extension workers, researchers, financing institutions.* *4) States should establish suitable incentives and disincentives to encourage responsible aquaculture practices.* *5) States should hold regular dialogues with producers to determine ways to maintain or increase production through responsible aquaculture practices.* *6) States should institute data reporting systems (covering farm facilities, inputs, production, markets, disease outbreaks, etc.) involving farmers and farmer organizations. Data reporting may be required for issuance of licenses and permits.* *7) States should make aquaculture jobs available to men and women and ensure occupational safety and security for all aquaculture workers.*

Technology transfer, extension
Training, information dissemination, on-farm demonstration, technical assistance, and other ways to move the technology from the research laboratory to the commercial fish farm

Incentives
Policies, regulations, financial assistance, and other ways to encourage good farm practices or use of better technologies

Disincentives
Policies, regulations, financial assistance, and other ways to discourage use of inefficient or destructive technologies, or bad farm practices

Benefits of association and self-regulation

Major benefits can be derived from association in producer organizations and the development of voluntary codes of practice and guidelines.

- Aquaculturists associated by agreement on common standards and objectives are in a better position to defend their interests and to negotiate for rights and privileges against competing interests.
- Public image of the aquaculture sector can be improved by adherence to established norms and adequate self-regulation.
- There will be greater understanding and agreement on specific measures which can or should be implemented to ensure sustainable aquaculture.
- Roles and responsibilities of persons, interest groups or institutions, private or public, can be identified and negotiated, with a view to assure and confirm their commitment and contribution to sustainable aquaculture.
- As part of integrated area management, responsible aquaculture acknowledges its interaction with other sectors in the conservation and efficient use of resources and therefore, can request that those sectors do not compromise the availability of resources of adequate quantity and quality required by aquaculture and fisheries.

Record keeping

In the interest of efficiency in operation and effective accumulation of experience in management of hatcheries, aquafarms, and water bodies used for enhanced fish production, records should be maintained on the quantities and origin of all inputs, including species or strains used, harvests and sales, and other operational and financial data. Such records are valuable in case of disease outbreaks or accidents to stocks or workers, and in understanding if and where mistakes were made. Further, the records may be vital in defending the operation against any claims by outsiders of mismanagement or irresponsible action. (FAO 1997)

Participation in research

Research efforts for aquaculture should aim at improved aquafarming methods, with a clear focus on the development of sustainable aquaculture systems, bearing in mind the need for increased food supply and poverty eradication. Renewed efforts should be made to involve aquatic and terrestrial farmers, their organizations and their communities in setting research priorities and directions, including specific objectives and needs for particular research projects, and to make research findings accessible to them.

Training, extension, and capacity-building at the farm level

Rural areas in many developing countries are generally poorly equipped in terms of technical and financial resources and educational infrastructure. Serious food security and other economic problems can result from lack of income opportunities; failure to crop and to maintain production; inadequate distribution of commodities, inputs and consumer goods; and limited access to public services.

Appropriate and up-to-date technologies in both terrestrial and aquatic farming are required to promote modernization of local production methods. Full benefit from such technologies would require training, education, and skill development programs for local managers and workers. To do these, the relevant aquaculture authorities, aquafarmers, and their communities can collaborate with agricultural extension workers who may have wider reach. (FAO 1997)

Original Article	*Regional Guidelines*
Article 9.4.3 States should promote efforts which improve selection and use of appropriate feeds, feed additives and fertilizers, including manures.	*1) States should establish research-based quality standards for feeds and feed additives and guidelines for their proper selection and use.* *2) States should provide information on, and develop appropriate guidelines for the use of locally available materials as feeds.* *3) States should support research and development on potential feed ingredients and alternative protein sources to minimize the use of fish meal and food fish in aquaculture.* *4) States should establish and disseminate guidelines for the proper selection and use of fertilizers and manures.*

Feeds
Fresh food materials, or formulated diets processed into pellets, given to farmed animals

Feed ingredients
Materials used as sources of protein, fats, and other nutrients in the manufacture of formulated feeds for farmed fish and livestock

Fish meal
Dried and powdered fish used as the main protein source in the manufacture of feeds for farmed fish and livestock

Feed additives
Preservatives, dyes, attractants, and other materials added to formulated feeds to improve and maintain quality

Fertilizers
Materials high in nitrogen, phosphorus, potassium, or organic matter that are used to enhance plankton production in aquafarms

Manure
Fecal material and compost used to increase the organic matter and nutrient content of the soil in aquafarms

Selection and use of feeds and additives

The responsible use of feeds (and additives where necessary) contributes both to efficient production and reduced impacts on the environment. Feed manufacturers and suppliers have a responsibility to provide appropriate quality feeds, and to assist farmers in managing and presenting these feeds on farm in ways that facilitate efficient and optimum uptake by the stock. In many cases, supplementary feeds may be used instead of, or in addition to factory-made feeds, and locally available ingredients may be used.

Use of additives requires care in adjusting the quantities and rates of delivery to obtain desired effects with minimum waste, and also allowing withdrawal periods to free products from all contamination. Use of antibiotics in feeds (if at all) should be carried out only with prescription and supervision of a veterinarian or equivalent qualified officer. (FAO 1997)

Original Article	*Regional Guidelines*
Article 9.4.4 States should improve effective farm and fish health management practices favouring hygienic measures and vaccines. Safe, effective and minimal use of therapeutants, hormones and drugs, antibiotics and other disease control chemicals should be ensured.	*1) States should establish guidelines for effective farm and aquaculture health management, emphasizing preventive measures, good husbandry, and responsible use of chemotherapeutants.* *2) States should document the chemical nature, incidence and manner of use, and behavior of chemotherapeutants in aquaculture.* *3) States should establish and enforce appropriate regulations in the use of therapeutants, hormones, and antibiotics and disease-control chemicals in aquaculture.* *4) States should establish the authority for prescribing aquaculture drugs and ensure that qualified professionals are licensed for the purpose.* *5) States should establish a system or support the existing systems for monitoring and reporting disease outbreaks and informing aquafarmers of disease incidence and effective control measures.* *6) States should support research and development in aquaculture health management, including husbandry techniques, pathogenesis, and vaccines for important diseases.*
Article 9.4.5 States should regulate the use of chemical inputs in aquaculture which are hazardous to human health and the environment.	*1) States should monitor, document and regulate chemical inputs in aquaculture, establish and enforce strict regulations on their use, and ban those that are hazardous to human health and the environment. Information on these banned chemicals must be widely disseminated.*

Hormones
Organic substances produced by a group of cells that affect the activity of other target cells

(Chemo)therapeutants
Chemicals and other substances used for the prevention and control of disease

Antibiotics
Natural or synthetic chemicals that inhibit the growth or kill bacteria and other microbes.

Stress and fish health

Incidence and severity of infectious diseases are very often dependent on the quality of the environment in which the organism lives. Thus, the first and most important step in controlling infectious disease is by maintaining the best quality environment possible in the farming unit to minimize stress on the stock.

Stress in fish can be defined as the alteration of one or more physiological variables to the point that survival may be impaired in the long term. Such alterations often result from changes in the physicochemical, biological, and microbial quality of the aquatic environment, and the feed and space availability.

Stress can be reduced by maintaining realistic stocking densities and providing best farm conditions. Reduction in stress will minimize the risk of becoming infected and thus reduce mortality and related losses. Collaboration among farmers, extensionists, and fish health experts should be promoted to increase awareness and capacity in fish health maintenance and farm management. (FAO 1997)

Health management

Maintaining farmed animals in good health through proper husbandry, effective diet, good water quality, optimum stocking rate, low stress, and exclusion or inhibition of disease organisms. Includes prevention, monitoring, control, and treatment of diseases

Husbandry

The practices and procedures of taking care of farmed animals and plants

Pathogenesis

How a disease develops given a particular set of host organism, disease organism (pathogen), and environmental conditions

Office International des Epizooties

The OIE is an intergovernmental organization created by an International Agreement signed by 28 countries on 25 January 1924. By May 2004, the OIE already has 167 member Countries. The objectives of the OIE are:

To ensure transparency in the global animal disease situation

Each Member Country undertakes to report the animal diseases detected within its territory. The OIE then disseminates the information to other countries, which can take the necessary preventive action. This information also includes diseases transmissible to humans and intentional introduction of pathogens. Information is sent out immediately or periodically depending on the seriousness of the disease. This objective applies to disease occurrences both naturally occurring and deliberately caused.

To collect, analyze, and disseminate veterinary scientific information

The OIE collects and analyses the latest scientific information on animal disease control. This information is then made available to the Member Countries to help them improve the methods used to control and eradicate these diseases. Guidelines are prepared by the network of 156 OIE Collaborating Centres and Reference Laboratories across the world.

To provide expertise and encourage international solidarity in the control of animal diseases

The OIE provides technical support to Member Countries requesting assistance in animal disease control and eradication, including diseases transmissible to humans. The OIE notably offers expertise to the poorest countries to help them control animal diseases that cause livestock losses, present a risk to public health, and threaten other Member Countries.

Use of drugs to control disease

An adequate range of tested and approved drugs to treat aquatic diseases should be available to fish producers, and guidelines and training in responsible use should be available. Use of such drugs should be under veterinary supervision, and the marketing and use of drugs that have not been certified for aquatic use should be strictly regulated, if not prohibited. To ensure maximum and continuing effectiveness of antibiotics for aquatic farming and especially for treatment of human diseases, preventative use of antibiotics should be avoided. (FAO 1997)

Use of hormones

Hormones are sometimes being used in some forms of aquaculture for inducing or preventing sexual maturation, for sex reversal, and for promoting growth. Hormone use in aquaculture is not well documented and sometimes carried out without adequate understanding of the quantities needed, and of their fate in the environment. When hormones are used for regulating reproduction, contamination of the product is unlikely. When growth promoters are used, there should be careful documentation of use, and withdrawal periods after harvest should be observed. (FAO 1997)

Regulating chemicals in aquaculture

The misuse of some chemicals (for example, the excessive use of antibiotics for prophylaxis) is often due to aquafarmers lacking access to information on appropriate use, or due to the lack of effective yet economic alternative chemicals or management measures that reduce use of hazardous chemicals.

In order to promote responsible, safe, and effective use of chemicals in aquaculture, competent government authorities should work together to clarify and specify relevant mandates and responsibilities of various line agencies in charge of public health and food quality, agriculture, animal health services, environment, etc. to develop enforceable and practical aquaculture-specific provisions and guidelines.

Aquafarmers, researchers, and pharmaceutical and pesticide manufacturing industries should collaborate to allow for testing and licensing of chemicals for use in aquaculture, as well as for formulation of sound and effective regulatory instruments on the production, distribution, and use of chemicals known to be hazardous to human health and the environment. (FAO 1997)

Probiotics
Originally meant food or feed products (for people and farm animals) containing beneficial bacteria that improve nutrition; now also refers to products (properly called waste digesters) applied to water, soil, or sludge to hasten breakdown of organic matter

Vaccine
Suspension of dead or ineffective disease organisms that may be injected or fed to a healthy animal to stimulate production of antibodies against the disease

Chemical inputs
Substances applied to ponds or hatcheries to alter the environment for the benefit of the farmed species. The intended effects can be increased fertility, elimination of unwanted organisms, promotion of the growth of beneficial organisms, or prevention or management of diseases.

Aquaculture drugs
Substances applied to soil or water or added to feeds for the purpose of preventing, managing or treating disease, promoting the growth, changing the sex, or otherwise changing the physiological condition of farmed organisms

Original Article	*Regional Guidelines*
Article 9.4.6 States should require that the disposal of wastes such as offal, sludge, dead or diseased fish, excess veterinary drugs and other hazardous chemical inputs does not constitute a hazard to human health and the environment.	*1) States should establish guidelines and regulations to ensure proper disposal of wastes from aquaculture facilities - sludge, diseased or contaminated fish, offal, excess veterinary drugs, and other hazardous chemical inputs.* *2) States should define standards for effluents especially those from intensive aquaculture farms and hatcheries.* *3) States should require large-scale farms and assist groups of small-scale farms to include wastewater treatment (e.g., by means of settling ponds or biofiltration by seaweeds, mangroves, and filter feeding mollusks) and recycling in the farming system. Compliance may be required for the issuance of licenses and permits.* *4) States should institute a system for communication and cooperation among aquafarmers and other users of water resources and potential users of sludge and other farm byproducts.*
Article 9.4.7 States should ensure the food safety of aquaculture products and promote efforts which maintain product quality and improve their value through particular care before and during harvesting and on-site processing and in storage and transport of the products.	*1) States should monitor and document methods and practices in farming, harvesting, processing, storage, and transport of aquaculture products and institute a system for correction and improvement.* *2) States should establish and implement guidelines for aquaculture practices that ensure food safety and high quality and value of aquaculture products. Guidelines can include the Hazard Analysis and Critical Control Points or HACCP.* *3) States should support research and development on food safety including toxin diagnostics and monitoring.*

Eong YS, Hariono I (eds). 2003. The Application of HACCP in the Fish Processing Industry in Southeast Asia 2000-2003. SEAFDEC Marine Fisheries Research Department, Singapore, 150 pp.

Offal
Waste products from abattoir, poultry dressing plants, or fish processing plants. Fish offal consists of entrails, heads, gills, fins, and other parts not usually used for human consumption

Effluents
Waste water from fish and shrimp grow-out ponds and tanks; the water contains silt, uneaten feeds, feces, dead organisms, molted exoskeleton, dissolved nutrients, and other waste products of metabolism and environmental processes

Sludge
Materials that accumulate at the bottom of aquaculture ponds, tanks, and pens, or below cages and rafts

Wastewater or effluent treatment
Process of cleaning up effluents or wastewater by passing it through a series of facilities and processes including settling and biofiltration

Settling ponds
Earthen ponds or concrete tanks where effluents from fish ponds are passed through or held for some time long enough for particulate materials (uneaten feeds, feces, plankton, silt) to settle out from the water

Biofiltration
Removal of suspended particles and dissolved nutrients by passing the effluents through a population of filter feeders (oysters and mussels), seaweeds and microalgae, and a sand filter with ammonia- and nitrite-oxidizing bacteria

Recycling
Processing waste materials into useful farm inputs; e.g., animal manures into organic fertilizer for plants and feeds for small animals

Effluent standards
Water quality criteria applied to effluents from fish and shrimp farms

Example of effluent quality criteria
For marine shrimp farms in Thailand, see page 17.

Harvesting and product quality

A good quality product is not only a responsibility of the producer, but is an important factor in long-term financial profitability and growth. Good farms and good farm managers know that product quality depends on proper management throughout the entire production cycle.

Nevertheless, particular care is necessary in the period leading up to harvest, in harvesting and on-site processing, and in storage and transport of the products. Prior to harvesting, it is important that the stocks have been freed from any residual drugs or hormones used, and their digestive tracts freed of algal or other materials that produce off-flavors. Harvesting should be carried out quickly and efficiently to minimize damage or contamination. Availability of adequate storage and/or immediate transport should be ensured before harvesting is started. (FAO 1997)

HACCP
Hazard Analysis Critical Control Points: a system that identifies, evaluates, and controls hazards significant for food safety

Toxin diagnostics
Methods to detect, identify, and quantify toxic substances in aquafarm products

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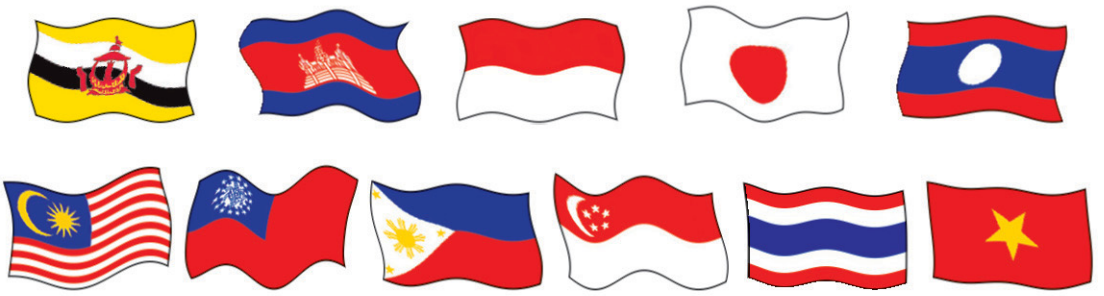

The Southeast Asian Fisheries Development Center (SEAFDEC) is a regional treaty organization established in December 1967 to promote fisheries development in the region. The Member Countries are Brunei Darussalam, Cambodia, Indonesia, Japan, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam. The policy-making body of SEAFDEC is the Council of Directors, made up of representatives of the Member Countries.

SEAFDEC conducts research on fisheries problems; generates appropriate fisheries technologies; trains researchers, technicians, fishers and aquafarmers, and managers; disseminates information on fisheries science and technologies; and recommends policies pertaining to the fisheries sector.

SEAFDEC has four Departments that focus on different aspects of fisheries development:

- The Training Department (TD) in Samut Prakan, Thailand for training in marine capture fisheries
- The Marine Fisheries Research Department (MFRD) in Singapore for post-harvest technologies
- The Aquaculture Department (AQD) in Tigbauan, Iloilo, Philippines for aquaculture research and development
- The Marine Fishery Resources Development and Management Department (MFRDMD) in Kuala Terengganu, Malaysia for the development and management of fishery resources in the exclusive economic zones of SEAFDEC Member Countries

SEAFDEC/AQD is mandated to:

- Conduct scientific research to generate aquaculture technologies appropriate for Southeast Asia
- Develop managerial, technical, and skilled manpower for the aquaculture sector
- Disseminate and exchange aquaculture information
- Conduct other activities as assigned by the SEAFDEC Council

The Aquaculture Department in the Philippines maintains four stations: the Tigbauan Main Station and Dumangas Brackishwater Station in Iloilo; the Igang Marine Station in Guimaras; and the Binangonan Freshwater Station in Rizal.